

CLAIMS

We claim:

1. A die, comprising:

a substrate; and

one or more pillar structures formed over the substrate in a pattern.

2. The die of claim 1, wherein the one or more pillar structures have a rectangular shape, a round shape, a ring shape, a wall-like shape or a spline shape.

3. The die of claim 1, wherein the one or more pillar structures have a rectangular shape with a length of from about 789.0 to 1289.0 μm and a width of about 289.0 μm .

4. The die of claim 1, wherein the one or more pillar structures have a rectangular shape with a length of about 789.0 μm and a width of about 289.0 μm .

5. The die of claim 1, wherein the one or more pillar structures have a rectangular shape with a length of about 1289.0 μm and a width of about 289.0 μm .

6. The die of claim 1, wherein the one or more pillar structures have a rectangular shape and the pillar structures are spaced apart lengthwise by about 500.0 μm center-to-center and by about 211.0 μm end-to-end.

7. The die of claim 1, wherein the one or more pillar structures have a round shape with a diameter of about 289.0 μm .
8. The die of claim 1, wherein the one or more pillar structures have a round shape with a diameter of about 289.0 μm ; the pillar structures being arranged at least in part in rows and columns with the adjacent round pillar structures being spaced apart by about 500.0 μm .
9. The die of claim 1, wherein the pillar structure pattern includes a series of rows and columns.
10. The die of claim 1, wherein the pillar structure pattern 100 includes a series of rows and columns; the pillar structures arranged in the series of rows and columns are spaced apart lengthwise by about 500.0 μm center-to-center in the columns and are spaced apart about 211.0 μm end-to-end.
11. The die of claim 1, wherein the one or more pillar structures include at least one wall-shaped pillar structure.
12. The die of claim 1, wherein the one or more pillar structures include at least one wall-shaped pillar structure forming a square.
13. The die of claim 1, including a pillar wall.
14. The die of claim 1, wherein the one or more pillar structures are comprised of a lead-free material.

15. The die of claim 1, wherein the one or more pillar structures are comprised of copper.

16. The die of claim 1, wherein the one or more pillar structures are comprised of copper coated with oxide, chromium or nickel.

17. The die of claim 1, wherein the one or more pillar structures are comprised of a lower copper layer and an overlying solder layer.

18. The die of claim 1, wherein the one or more pillar structures are comprised of a lower copper layer and an overlying reflowed solder layer.

19. The die of claim 1, wherein the one or more pillar structures are comprised of a lower copper layer and an overlying solder layer; the solder layer being comprised of:

from about 60 to 70% tin and from about 30 to 40% lead;

about 63% tin and 37% lead;

about 99% tin and SnAg; or

100% tin.

20. The die of claim 1, wherein the one or more pillar structures are comprised of a lower copper layer and an overlying solder layer; the solder layer being comprised of:

about 63% tin and 37% lead; or

100% tin.

21. The die of claim 1, wherein the one or more pillar structures are comprised of a lower copper layer and an overlying reflowed solder layer; the pillar structures having a total height of from about 60 to 150 μm .
22. The die of claim 1, wherein the one or more pillar structures are comprised of a lower copper layer and an overlying reflowed solder layer; the pillar structures having a total height of about 100 μm .
23. The die of claim 1, wherein the die is used in Surface Acoustic Wave devices and in MEM devices.
24. A die, comprising:
a substrate; and
one or more pillar structures formed over the substrate in a pattern; the one or more pillar structures having a rectangular shape, a round shape, a ring shape, a
5 wall-like shape or a spline shape.
25. The die of claim 24, wherein the one or more pillar structures have a rectangular shape with a length of from about 789.0 to 1289.0 μm and a width of about 289.0 μm .
26. The die of claim 24, wherein the one or more pillar structures have a rectangular shape with a length of about 789.0 μm and a width of about 289.0 μm .

27. The die of claim 24, wherein the one or more pillar structures have a rectangular shape with a length of about 1289.0 μm and a width of about 289.0 μm .

28. The die of claim 24, wherein the one or more pillar structures have a rectangular shape and the pillar structures are spaced apart lengthwise by about 500.0 μm center-to-center and by about 211.0 μm end-to-end.

29. The die of claim 24, wherein the one or more pillar structures have a round shape with a diameter of about 289.0 μm .

30. The die of claim 24, wherein the one or more pillar structures have a round shape with a diameter of about 289.0 μm ; the pillar structures being arranged at least in part in rows and columns with the adjacent round pillar structures being spaced apart by about 500.0 μm .

31. The die of claim 24, wherein the pillar structure pattern includes a series of rows and columns.

32. The die of claim 24, wherein the pillar structure pattern 100 includes a series of rows and columns; the pillar structures arranged in the series of rows and columns are spaced apart lengthwise by about 500.0 μm center-to-center in the columns and are spaced apart about 211.0 μm end-to-end.

33. The die of claim 24, wherein the one or more pillar structures include at least one wall-shaped pillar structure.

34. The die of claim 24, wherein the one or more pillar structures include at least one wall-shaped pillar structure forming a square.

35. The die of claim 24, including a pillar wall.

36. The die of claim 24, wherein the one or more pillar structures are comprised of a lead-free material.

37. The die of claim 24, wherein the one or more pillar structures are comprised of copper.

38. The die of claim 24, wherein the one or more pillar structures are comprised of copper coated with oxide, chromium or nickel.

39. The die of claim 24, wherein the one or more pillar structures are comprised of a lower copper layer and an overlying solder layer.

40. The die of claim 24, wherein the one or more pillar structures are comprised of a lower copper layer and an overlying reflowed solder layer.

41. The die of claim 24, wherein the one or more pillar structures are comprised of a lower copper layer and an overlying solder layer; the solder layer being comprised of:

from about 60 to 70% tin and from about 30 to 40% lead;

about 63% tin and 37% lead;

about 99% tin and SnAg; or

100% tin.

42. The die of claim 24, wherein the one or more pillar structures are comprised of a lower copper layer and an overlying solder layer; the solder layer being comprised of:

about 63% tin and 37% lead; or

100% tin.

43. The die of claim 24, wherein the one or more pillar structures are comprised of a lower copper layer and an overlying reflowed solder layer; the pillar structures having a total height of from about 60 to 150 μm .

44. The die of claim 24, wherein the one or more pillar structures are comprised of a lower copper layer and an overlying reflowed solder layer; the pillar structures having a total height of about 100 μm .

45. The die of claim 24, wherein the die is used in Surface Acoustic Wave devices and in MEM devices.

46. A method of forming a die, comprising the steps:

providing a substrate; and

forming one or more pillar structures over the substrate in a pattern.

47. The method of claim 46, wherein the one or more pillar structures have a rectangular shape, a round shape, a ring shape, a wall-like shape or a spline shape.

48. The method of claim 46, wherein the one or more pillar structures have a rectangular shape with a length of from about 789.0 to 1289.0 μm and a width of about 289.0 μm .

49. The method of claim 46, wherein the one or more pillar structures have a rectangular shape with a length of about 789.0 μm and a width of about 289.0 μm .

50. The method of claim 46, wherein the one or more pillar structures have a rectangular shape with a length of about 1289.0 μm and a width of about 289.0 μm .

51. The method of claim 46, wherein the one or more pillar structures have a rectangular shape and the pillar structures are spaced apart lengthwise by about 500.0 μm center-to-center and by about 211.0 μm end-to-end.

52. The method of claim 46, wherein the one or more pillar structures have a round shape with a diameter of about 289.0 μm .

53. The method of claim 46, wherein the one or more pillar structures have a round shape with a diameter of about 289.0 μm ; the pillar structures being arranged at least in part in rows and columns with the adjacent round pillar structures being spaced apart by about 500.0 μm .

54. The method of claim 46, wherein the pillar structure pattern includes a series of rows and columns.

55. The method of claim 46, wherein the pillar structure pattern 100 includes a series of rows and columns; the pillar structures arranged in the series of rows and columns are spaced apart lengthwise by about 500.0 μm center-to-center in the columns and are spaced apart about 211.0 μm end-to-end.

56. The method of claim 46, wherein the one or more pillar structures include at least one wall-shaped pillar structure.

57. The method of claim 46, wherein the one or more pillar structures include at least one wall-shaped pillar structure forming a square.

58. The method of claim 46, including a pillar wall.

59. The method of claim 46, wherein the one or more pillar structures are comprised of a lead-free material.

60. The method of claim 46, wherein the one or more pillar structures are comprised of copper.

61. The method of claim 46, wherein the one or more pillar structures are comprised of copper coated with oxide, chromium or nickel.

62. The method of claim 46, wherein the one or more pillar structures are comprised of a lower copper layer and an overlying solder layer.

63. The method of claim 46, wherein the one or more pillar structures are comprised of a lower copper layer and an overlying reflowed solder layer.

64. The method of claim 46, wherein the one or more pillar structures are comprised of a lower copper layer and an overlying solder layer; the solder layer being comprised of:

from about 60 to 70% tin and from about 30 to 40% lead;

about 63% tin and 37% lead;

about 99% tin and SnAg; or

100% tin.

65. The method of claim 46, wherein the one or more pillar structures are comprised of a lower copper layer and an overlying solder layer; the solder layer being comprised of:

about 63% tin and 37% lead; or

100% tin.

66. The method of claim 46, wherein the one or more pillar structures are comprised of a lower copper layer and an overlying reflowed solder layer; the pillar structures having a total height of from about 60 to 150 μm .

67. The method of claim 46, wherein the one or more pillar structures are comprised of a lower copper layer and an overlying reflowed solder layer; the pillar structures having a total height of about 100 μm .

68. The method of claim 46, wherein the die formed is used in Surface Acoustic Wave devices and in MEM devices.